

CLAIMS

1. A composition for delivering a bioactive metal ion to a mammal, the composition comprising an effective amount of a source of the bioactive metal ion, a phosphoprotein preparation obtained by partially cross linking a partial hydrolysate of casein or a caseinate, and one or more physiologically acceptable diluents or carriers.
2. A composition according to claim 1, wherein the metal ion is divalent.
3. A composition according to claim 1 or 2, wherein the metal ion is selected from the group consisting of calcium, iron, zinc, cobalt, copper and magnesium.
4. A composition according to any one of claims 1 to 3, wherein the composition is an oral composition and comprises a foodstuff, beverage, or a pharmaceutical vehicle.
5. A composition according to any one of the preceding claims, wherein the pH of the composition is between about 6 and about 9.
6. A composition according to any one of the preceding claims, wherein the composition comprises a processed cheese product, and the source of a bioactive metal ion comprises natural milk calcium phosphate.
7. A composition according to any one of the preceding claims, wherein the partial hydrolysate has been obtained by enzymatic hydrolysis of acid casein, rennet casein or a caseinate.
8. A composition according to claim 7, wherein the enzyme is trypsin.
9. A composition according to claim 7 or 8, wherein the degree of hydrolysis is in the range of about 3% to about 8% of the total number of peptide bonds.

10. A composition according to claim 9, wherein the degree of hydrolysis is in the range of about 3.5% to about 7%.
11. A composition according to claim 9, wherein the degree of hydrolysis is in the range of about 4% to about 6.5%.
12. A composition according to any one of the preceding claims, wherein the degree of hydrolysis is such that about 10% or less of the casein or caseinate is rendered insoluble at pH 7, by the partial hydrolysis.
13. A composition according to claim 12, wherein the degree of hydrolysis is such that about 5 % or less of the casein or caseinate is rendered insoluble at pH 7, by the partial hydrolysis.
14. A composition according to any one of the preceding claims, wherein the partial hydrolysate has been partially cross linked enzymatically, using the enzyme transglutaminase.
15. A composition according to any one of the preceding claims, wherein the degree of partial cross linking is such that the resulting phosphoprotein preparation comprises about 10 or more μmol cross links per gram of protein.
16. A composition according to any one of the preceding claims, wherein the degree of partial cross linking is such that the resulting phosphoprotein preparation comprises between about 10 and about 250 μmol cross links per gram of protein.
17. A composition according to any one of the preceding claims, wherein the degree of partial cross linking is such that the resulting phosphoprotein preparation comprises between about 50 and about 160 μmol cross links per gram of protein.
18. A method of delivering a bioactive metal ion to a mammal, comprising administering to the mammal a composition according to any one of the preceding claims.

19. A composition for remineralising tooth enamel and/or for treating or preventing dental caries, tooth erosion, dentinal hypersensitivity or gingivitis in a mammal, wherein the composition comprises an effective amount of a phosphoprotein preparation in combination with one or more carriers or diluents, wherein the phosphoprotein preparation has been obtained by partially cross linking a partial hydrolysate of casein or a caseinate.
20. A composition according to claim 19, wherein the partial hydrolysate has been obtained by enzymatic hydrolysis or acid casein, rennet casein or a caseinate.
21. A composition according to claim 20, wherein the enzyme is trypsin.
22. A composition according to any one of claims 19 to 21, wherein the degree of hydrolysis is in the range of about 3% to about 8% of the total number of peptide bonds.
23. A composition according to claim 22, wherein the degree of hydrolysis is in the range of about 3.5% to about 7%.
24. A composition according to claim 22, wherein the degree of hydrolysis is in the range of about 4% to about 6.5%.
25. A composition according to any one of claims 19 to 24, wherein the degree of hydrolysis is such that about 10% or less of the casein or caseinate is rendered insoluble at pH 7, by the partial hydrolysis.
26. A composition according to claim 25, wherein the degree of hydrolysis is such that about 5% or less of the casein or caseinate is rendered insoluble at pH 7, by the partial hydrolysis.
27. A composition according to any one of claims 19 to 26, wherein the partial hydrolysate has been partially cross linked enzymatically, using the enzyme transglutaminase.

28. A composition according to any one of claims 19 to 27, wherein the degree of partial cross linking is such that the resulting phosphoprotein preparation comprises about 10 or more μmol cross links per gram of protein.
29. A composition according to claim 28, wherein the degree of partial cross linking is such that the resulting phosphoprotein preparation comprises between about 10 and about 250 μmol cross links per gram of protein.
30. A composition according to claim 28, wherein the degree of partial cross linking is such that the resulting phosphoprotein preparation comprises between about 50 and about 160 μmol cross links per gram of protein.
31. A composition according to any one of claims 19 to 30, further comprising a source of calcium ions.
32. A composition according to claim 31, wherein the composition further comprises a source of phosphate ions.
33. A composition according to claim 30, wherein the composition further comprises calcium phosphate.
34. A composition according to claim 30, wherein the composition further comprises natural milk calcium.
35. A composition according to any one of claims 31 to 34, wherein calcium ions are present in the composition at a level of at least about 5 mmol calcium ions per gram of phosphoprotein preparation.
36. A composition according to claim 35, wherein calcium ions are present in the composition at a level of at least about 10 mmol calcium ions per gram of phosphoprotein.

37. A composition according to any one of claims 32 to 36, wherein the molar ratio of calcium ions to phosphate ions is in the range of about 0.8-1.2:0.4-0.8.
38. A composition according to claim 37, wherein the molar ratio of calcium ions to phosphate ions is about 1:0.6.
39. A composition according to any one of claims 19 to 30, wherein the composition further comprises a source of strontium ions.
40. A composition according to claim 39, wherein the composition further comprises a source of fluoride ions.
41. A composition according to any one of claims 19 to 40, wherein the composition comprises a mouthwash, a dentifrice, toothpaste, a powder, an emulsion or a gel.
42. A composition according to any one of claims 19 to 33, wherein the composition comprises an emulsion, wherein the phosphoprotein preparation is present in an amount of about 1 % to about 15% by weight of the emulsion, and the emulsion further comprises natural milk calcium phosphate, in an amount of about 3% to about 12% by weight of the emulsion.
43. A composition according to any one of claims 19 to 40, wherein the composition comprises a foodstuff or a confection.
44. A method for remineralising tooth enamel and/or for treating or preventing dental caries, tooth erosion, dentinal hypersensitivity or gingivitis in a mammal, the method comprising contacting the teeth of the mammal with a composition according to any one of claims 19 to 43.
45. A phosphoprotein preparation, which has been obtained by partially cross linking a partial hydrolysate of casein or a caseinate, and wherein the degree of partial hydrolysis of the casein or caseinate prior to cross linking is in the range of about 3% to about 8% of the total number of peptide bonds, and the degree of partial cross linking is such that the

phosphoprotein preparation comprises about 10 or more μmol cross links per gram of protein.

46. A phosphoprotein preparation according to claim 45, wherein the degree of partial hydrolysis of the casein or caseinate prior to cross linking is in the range of about 3.5% to about 7%.
47. A phosphoprotein preparation according to claim 45, wherein the degree of partial hydrolysis of the casein or caseinate prior to cross linking is in the range of about 4% to about 6.5%.
48. A phosphoprotein preparation according to any one of claims 45 to 47, wherein the degree of partial cross linking is such that the phosphoprotein preparation comprises between about 10 and about 250 μmol cross links per gram of protein.
49. A phosphoprotein preparation according to any one of claims 45 to 47, wherein the degree of partial cross linking is such that the phosphoprotein preparation comprises between about 50 and about 160 μmol cross links per gram of protein.
50. A phosphoprotein preparation according to any one of claims 45 to 49, wherein the degree of hydrolysis is such that about 10% or less of the casein or caseinate is rendered insoluble at pH 7, by the partial hydrolysis.
51. A phosphoprotein preparation according to any one of claims 45 to 49, wherein the degree of hydrolysis is such that about 5% or less of the casein or caseinate is rendered insoluble at pH 7, by the partial hydrolysis.